NCT22, NCT24

Low Cost Single Trip Point Temperature Sensor

The NCT22 and NCT24 are programmable solid state temperature sensors designed to replace mechanical switches in sensing and control applications. Both devices integrate the temperature sensor with a voltage reference and all required detector circuitry. The desired temperature set point is set by the user with a single external resistor.

Ambient temperature is sensed and compared to the programmed setpoint. The OUT and $\overline{\text{OUT}}$ outputs are driven to their active state when the measured temperature exceeds the programmed setpoint.

The NCT22 has a power supply voltage range of 4.5 V to 18 V while the NCT24 operates over a power supply range of 2.7 V to 4.5 V. Both devices are useable over a temperature range of –40°C to +125°C. Both devices feature low supply current making them suitable for many portable applications.

The devices are offered in surface mount packages.

Features

- Temperature Set Point Easily Programs with a Single External Resistor
- Operates with 2.7 V Power Supply (NCT24)
- Small SOIC Package
- Cost Effective

Applications

- Power Supply Over–Temperature Detection
- Consumer Electronics
- Fire/Heat Detection
- UPSs, Amplifiers, Motors
- CPU Thermal Management in PCs

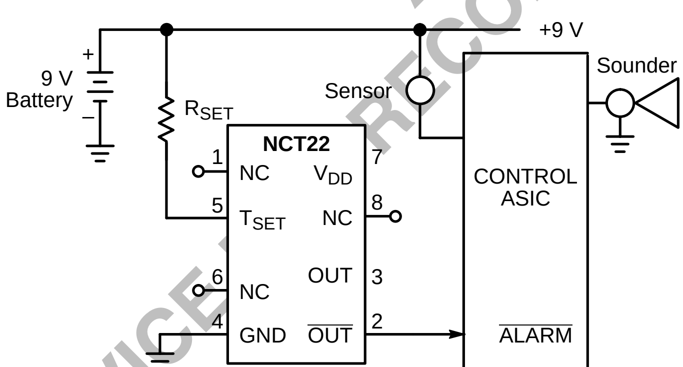
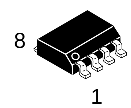


Figure 1. Heat Monitor for Smoke Detector

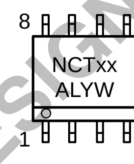
ON Semiconductor®

http://onsemi.com

MARKING DIAGRAM

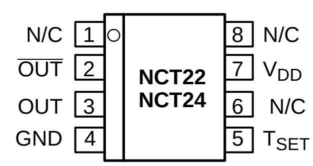


SOIC–8
D SUFFIX
CASE 751



xx = 22 or 24
A = Assembly Location
L = Wafer Lot
Y = Year
W = Work Week

PIN CONNECTIONS



(Top View)

ORDERING INFORMATION

See detailed ordering and shipping information in the package dimensions section on page 5 of this data sheet.

June, 2002 – Rev. 1
Publication Order Number:
NCT22/D

MAXIMUM RATINGS*

Rating	Symbol	Value	Unit
Supply Voltage NCT22 NCT24	V_{CC}	 20 5.5	V
Input Voltage (Any Input)	–	GND –0.3 to V_{DD} +0.3	V
Operating Temperature Range	–	–40 to +125	°C
Maximum Junction Temperature	–	+150	°C
Storage Temperature Range	T_{stg}	–65 to +150	°C
Lead Temperature (Soldering, 10 seconds)	–	+300	°C

*Stresses above those listed under “Absolute Maximum Ratings” may cause permanent damage to the device. These are stress ratings only and functional operation of the device at these or any other conditions above those indicated in the operational sections of the specifications is not implied. Exposure to Absolute Maximum Rating Conditions for extended periods may affect device reliability.

ELECTRICAL CHARACTERISTICS (Over Operating Temperature Range, unless otherwise specified)

Characteristics	Device	Test Conditions	Min	Typ	Max	Unit
Supply Voltage Range	NCT22 NCT24	–	4.5 2.7	– –	18 4.5	V
Supply Current	NCT22 NCT24	5.0 V ≤ V_{DD} ≤ 18 V 2.7 V ≤ V_{DD} ≤ 4.5 V	– –	200 170	600 300	µA
V_{OH}	NCT22	5.0 V ≤ V_{DD} ≤ 18 V –40°C ≤ T_A ≤ +125°C I_{OH} = 250 µA I_{OH} = 500 µA	 0.9 x V_{DD} 0.8 x V_{DD}	 – –	 – –	V
V_{OL}	NCT22	–40°C ≤ T_A ≤ +85°C I_{OL} = 500 µA I_{OL} = 1.0 mA –40°C ≤ T_A ≤ +125°C I_{OL} = 1.0 mA	 – – –	 – – –	 0.15 x V_{DD} 0.30 x V_{DD} 0.35 x V_{DD}	V
V_{OH}	NCT24	2.7 V ≤ V_{DD} ≤ 4.5 V –40°C ≤ T_A ≤ +125°C I_{OH} = 250 µA I_{OH} = 500 µA	 0.9 x V_{DD} 0.8 x V_{DD}	 – –	 – –	V
V_{OL}	NCT24	–40°C ≤ T_A ≤ +85°C I_{OL} = 500 µA I_{OL} = 1.0 mA –40°C ≤ T_A ≤ +125°C I_{OL} = 1.0 mA	 – – –	 – – –	 0.1 x V_{DD} 0.2 x V_{DD} 0.25 x V_{DD}	V
Absolute Accuracy	NCT22 NCT24	T_{SET} = Programmed Temperature T_{SET} = Programmed Temperature	T–5 T–5	T ± 1 T ± 1	T+5 T+5	°C
Trip Point Hysteresis	NCT22 NCT24	–	– –	2.0 2.0	– –	°C

DETAILED DESCRIPTION

Trip Point Programming

The NCT22 and NCT24 are single point temperature detectors ideal for use in a wide variety of applications. When the temperature of the device exceeds the programmed temperature trip point, T_{SET}, the OUT and $\overline{OUT}$ outputs are driven into their active states. The desired trip point temperature is programmed with a single external resistor connected between the T_{SET} input and V_{CC}. The relationship between the resistor value and the trip point temperature is given by the equation below.

$$R_{TRIP} = 0.5997 \times T^{2.1312}$$

Where Rtrip = Programming resistor value in Ohms

T = Desired trip temperature in degrees Kelvin.

For example, to program the device to trip at 50°C, the programming resistor is:

$$R_{TRIP} = 0.5997 \times ((50 + 273.15)^{2.1312}) = 133,652\ \Omega$$

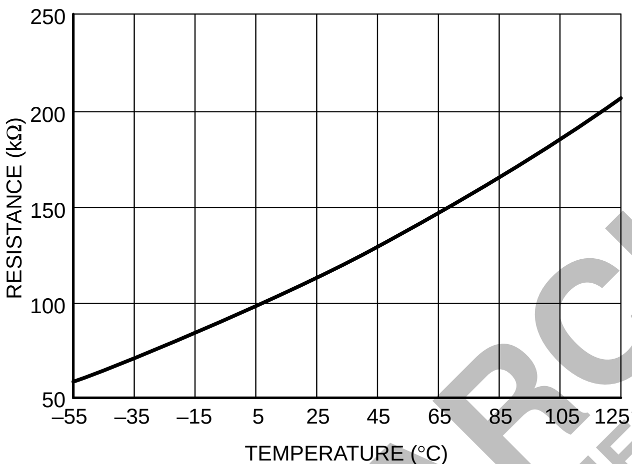


Figure 2. Programming Resistor Values vs. Temperature

Hysteresis

To prevent output “chattering’’ at the trip point temperature, the temperature detector in the NCT22/24 has 2°C of hysteresis (see Figure 3).

The outputs are driven active when the temperature crosses the setpoint determined by the external resistor. As temperature declines below the setpoint, the hysteresis action will hold the outputs true until the temperature drops 2°C below the threshold.

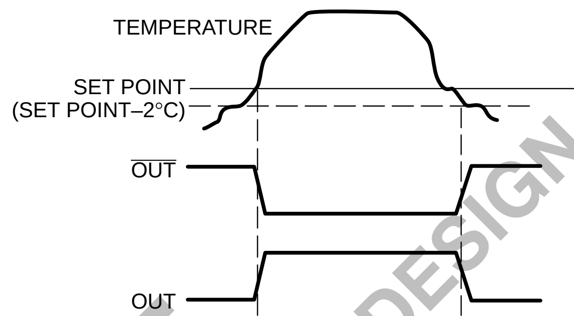


Figure 3. NCT22/24 Hysteresis

APPLICATIONS

Over–Temperature Shutdown

The NCT22 can be used to create a simple over–temperature shutdown circuit. In this circuit, temperature is sensed within the system enclosure (internal system ambient), or at the heatsink itself. When measured temperature exceeds a preset limit, a fault is indicated and the system shuts down.

Figure 4 illustrates a simple over–temperature shutdown circuit using the NCT22 sensor. As shown, the NCT22 outputs are driven active when the heatsink temperature equals the trip point temperature set by R_{SET}. When this happens, the crowbar circuit is activated, causing the supply output to fold back to zero. The NCT22 outputs remain active until the heatsink temperature falls a minimum of 2°C (built–in hysteresis) below the trip point temperature, at which time the device again allows normal supply operation.

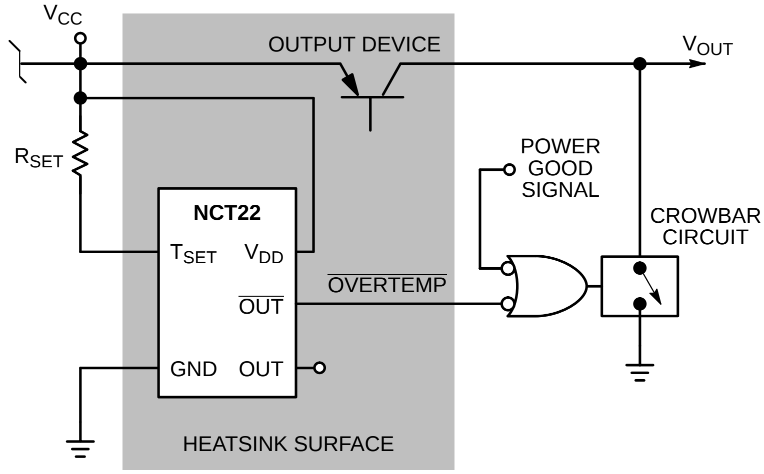


Figure 4. NCT22 Power Supply Over–Temperature Shutdown

Cooling and Heating Applications

The NCT22/24 can be used to control a DC fan as shown in Figure 5. The fan turns on when the sensed temperature rises above T_{SET} and remains on until the temperature falls below T_{SET} –2°C.

Figure 6 shows the NCT22 acting as a heater thermostat. Circuit operation is identical to that of the cooling fan application.

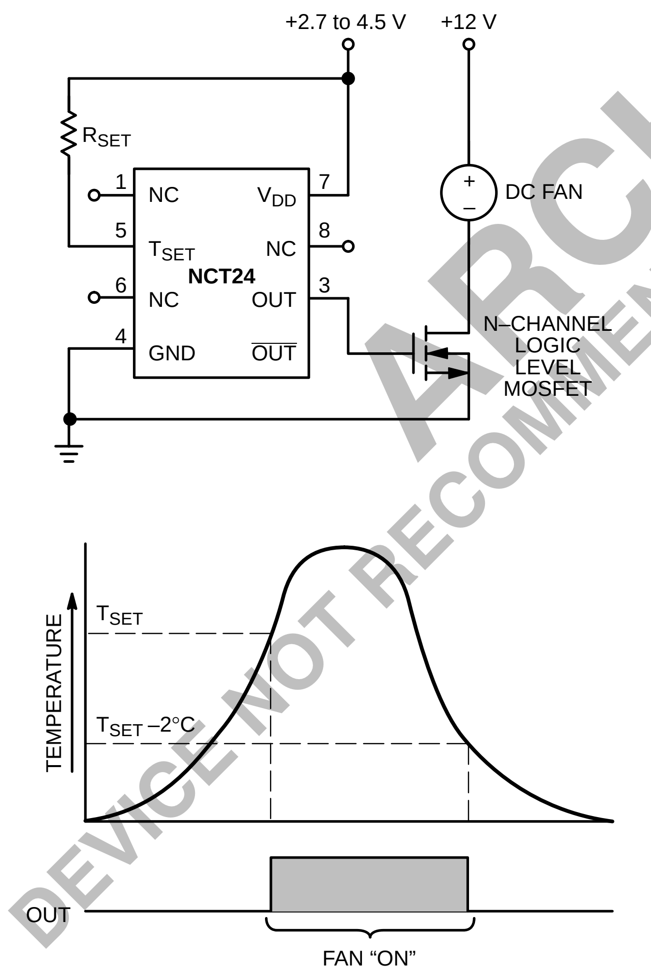


Figure 5. NCT24 As a Fan Controller for Notebook PCs

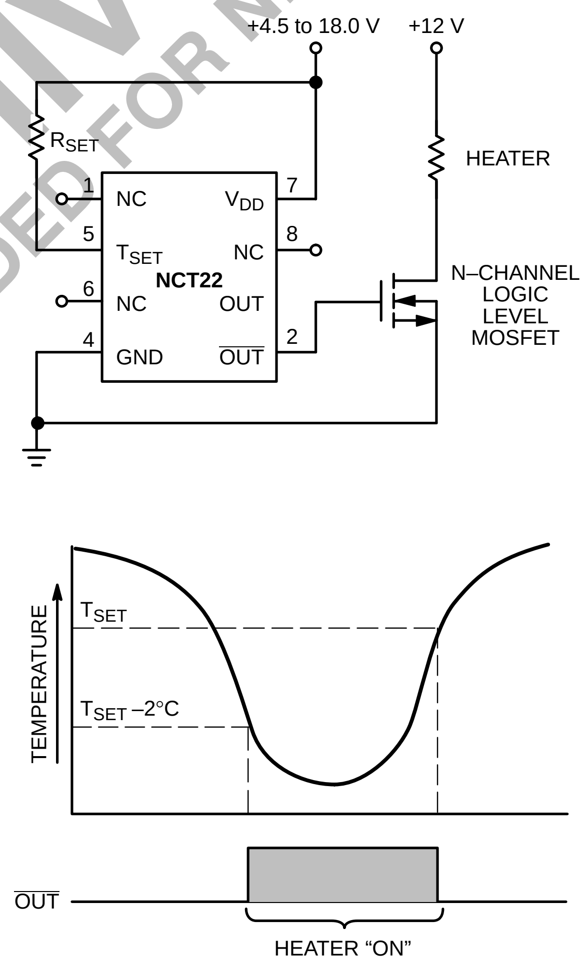


Figure 6. NCT22 As a Heater Thermostat

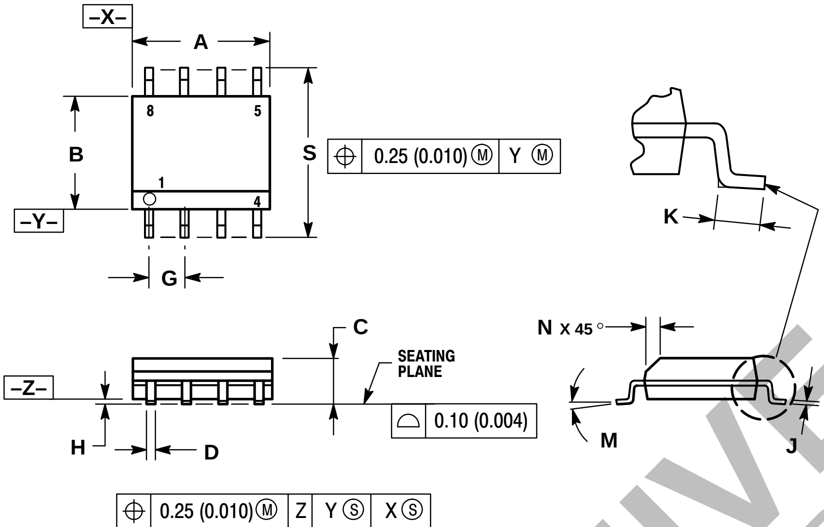
ORDERING INFORMATION

Device	Voltage Operation	Package	Ambient Temperature	Shipping
NCT22DR2	4.5 V to 18 V	SOIC–8	–40°C to +125°C	2500 Units Tape and Reel
NCT24DR2	2.7 V to 4.5 V	SOIC–8	–40°C to +125°C	2500 Units Tape and Reel

Notes

PACKAGE DIMENSIONS

SO–8
D SUFFIX
CASE 751–07
ISSUE V



NOTES:
1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
2. CONTROLLING DIMENSION: MILLIMETER.
3. DIMENSION A AND B DO NOT INCLUDE MOLD PROTRUSION.
4. MAXIMUM MOLD PROTRUSION 0.15 (0.006) PER SIDE.
5. DIMENSION D DOES NOT INCLUDE DAMBAR PROTRUSION. ALLOWABLE DAMBAR PROTRUSION SHALL BE 0.127 (0.005) TOTAL IN EXCESS OF THE D DIMENSION AT MAXIMUM MATERIAL CONDITION.

	MILLIMETERS		INCHES	
DIM	MIN	MAX	MIN	MAX
A	4.80	5.00	0.189	0.197
B	3.80	4.00	0.150	0.157
C	1.35	1.75	0.053	0.069
D	0.33	0.51	0.013	0.020
G	1.27 BSC		0.050 BSC	
H	0.10	0.25	0.004	0.010
J	0.19	0.25	0.007	0.010
K	0.40	1.27	0.016	0.050
M	0 °	8 °	0 °	8 °
N	0.25	0.50	0.010	0.020
S	5.80	6.20	0.228	0.244

PUBLICATION ORDERING INFORMATION

Literature Fulfillment:
Literature Distribution Center for ON Semiconductor
P.O. Box 5163, Denver, Colorado 80217 USA
Phone: 303–675–2175 or 800–344–3860 Toll Free USA/Canada
Fax: 303–675–2176 or 800–344–3867 Toll Free USA/Canada
Email: ONlit@hibbertco.com

N. American Technical Support: 800–282–9855 Toll Free USA/Canada

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ON Semiconductor Website: http://onsemi.com

For additional information, please contact your local Sales Representative.